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ABSTRACT

In October 1990, the Tennessee State Department of Education began a project to establish a plan for educational technology which will move the state into the 21st Century; from that plan a vision for the 21st Century Classroom and an implementation plan for the Tennessee Education Network have been developed. The purpose of this study was to examine the effectiveness of the 21st Century Classroom teacher training program in K-12 public schools. Perceptions and activities of 298 elementary and secondary teachers who received and utilized the 21st Century technology and participated in state-mandated training were investigated. A four-part instrument was used to gather data on: (1) demographics; (2) whether technology was used for specific tasks (lesson planning, record keeping, communication, and instructional presentation); (3) teachers' perceptions about the use of technology as measured by several constructs - voluntariness, relative advantage, compatibility, image, complexity, demonstrability, visibility, and trial ability; and (4) usefulness of the training topics of basic concepts, word processing, data base, spreadsheet, instructional software, optical technology, and telecommunications. Results indicate that technology training for teachers is required to implement technology in the classroom. (Contains 20 references.) (AEF)

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A STUDY OF 21ST CENTURY CLASSROOM TEACHERS' PERCEPTIONS REGARDING THE TRAINING AND USE OF TECHNOLOGY IN K-12 PUBLIC SCHOOLS IN TENNESSEE

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The underlying concern of school reform since the 1980s has been the capability of the United States to prepare its youth with skills to compete effectively in a global economy. Since the publication of A Nation at Risk in 1983 a number of reform efforts have occurred. In 1984 the U.S. Department of Education described in A Nation Responds Recent Efforts to Improve Education the following reform initiatives: site-based management, business-school partnerships, changes in vocational education, and the need for a technological revolution. Hundreds of state-level task forces addressed education issues, seeking ways to raise standards, improve textbooks, lengthen the school day or year, or improve the teaching profession. Business groups and universities became actively involved in collaborative programs to enhance primary and secondary education (Ravitch, 1995).

In the ten years following the publication of A Nation Responds: Recent Efforts to Improve Education, the southern states became leaders in education reform. Research has identified several specific areas as being important to the reform efforts. These included: (a) shared decision making and site-based management (Conley, 1991; Finn, 1991; Glickman, 1991); (b), school choice (Bell & Elmquist, 1991; Conley, 1991; Howe, 1991); (c) curriculum restructuring (Bell & Elmquist, 1991;Conley, 1991); (d) creating national standards and tests (Bell & Elmquist, 1991; Finn, 1991; Howe, 1991); and (e) enhancing school-community relationships and parental involvement (Bell & Elmquist, 1991; Conley, 1991).

In recent years, the number of at risk students has increased and their degree of "disadvantage" has also increased. In the report for the International Society for Technology Education, Braun (1991) examined several projects

across the country that revealed technology-enriched schools had a beneficial effect for at risk students.

There is a need to prepare more youth with skills because of the change in the nature of jobs. Technical and blue-collar jobs are disappearing. Peter Drucker (1993) maintained that "knowledge has become the key resource for all work. . . . and the only long term policy which promises success is for developed countries to convert manufacturing from being labor based into being knowledge based" (p.74). For students, the ability to use technology has come to be recognized as an indispensable skill. The Secretary's Commission on Achieving Necessary Skills (1991) stated this in these terms, "Those unable to use... [technology] face a lifetime of menial work"(p. 14).

The switch to more hands-on, problem-based, and interactive learning modes resulted out of such reforms as that supported by the National Council of Teachers of Mathematics in the 1980s. Increased use of technology appeared to move schools in the direction of active learning (Braun, 1991; Collins, 1991; Dwyer, 1994; Sheingold & Hadley, 1990).

Tennessee Historical Perspective

Educational reform in Tennessee was initiated by a 1981 comprehensive study funded by the State of Tennessee legislature prior to A Nation at Risk. The study resulted in the 1983 Better Schools Program proposed by Governor Lamar Alexander. The Better Schools Program was consistent with the first wave of reform proposals that were implemented in a number of states. Those proposals primarily emphasized greater control to improve teacher effectiveness. The State of Tennessee was viewed as a leader in this phase of education reform (Bellon, 1988).

Tennessee Education Network/ 21st Century Classroom Plan (1990)

In October 1990, the State Department of Education began a project, contracting with an outside consulting firm, to establish a plan for educational technology which will move the state into the 21st Century. From that plan a vision for the 21st Century Classroom and an implementation plan for the Tennessee Education Network have been developed.

The 21st Century Classroom defined the learning environment which will promote success for our students as we prepare them for the careers of the future and to become more competitive in a new global economy. The Tennessee Education Network (TEN) supplied management information to all levels within the education arena--from teachers requiring information on individual student needs assessment, to school boards making system-wide instructional plans, and to the State Department of Education in evaluating and planning statewide initiatives.

The purpose of this study was to investigate the effectiveness of the 21st Century Classroom teacher training program in Tennessee K-12 public schools. This was accomplished by investigating perceptions and activities of teachers who received and utilized the 21st Century technology and participated in state-mandated training. This was the first step in gauging the overall effect of the technology on teaching effectiveness in Tennessee. It is necessary to determine training effectiveness before subsequent studies can uncover the true influence of this technology on teaching methods.

Research Hypotheses

The effectiveness of training was measured by asking the respondents to evaluate the usefulness of topic areas which have been included in all training sessions for 21st Century Classroom teachers.

Based on the year the technology bundle was implemented and the grade level of the teacher the following hypotheses were investigated:

Hypothesis 1. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the training usefulness variables.

Hypothesis 2. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding professional activity variables.

Hypothesis 3. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of voluntariness.

Hypothesis 4. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of relative advantage.

Hypothesis 5. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of compatibility.

Hypothesis 6. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of image.

Hypothesis 7. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of complexity.

Hypothesis 8. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of demonstrability.

Hypothesis 9. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of observability.

Hypothesis 10. There is no significant difference ($p < .05$) in the perceptions of 21st Century teachers regarding the construct of trialability.

Definition of Terms

For the purpose of this study, the following terms were defined utilizing Technology Planning, (1992) published by the state of Tennessee.

21st Century Technology: A multimedia teacher workstation, a laser printer, laser disc player, CD-ROM drive, large screen television / monitor, minimum of two networked student workstations, and a minimum of $2000 spent on the purchase of instructional software.

21st Century teacher: Any K-12 Tennessee public school teacher who completed the minimum required thirty hour training including four hours for telecommunications and currently uses the 21st Century technology in a Tennessee classroom.

Training Usefulness: All 21st Century training includes seven topics which are basic concepts, word processing, data base, spreadsheet, instructional software, optical technology, and telecommunications. Respondents were asked to rate the usefulness of these topics in relation to their implementation of the 21st Century technology. This rating ranges from not useful to extremely useful.

Teaching Activities: These questions measured whether the respondents use the bundles for the following specific tasks: lesson planning, record keeping, communication, and instructional presentation.

The following constructs are measurements of teachers' perceptions about the use of the 21st Century technology bundle as an innovation in the classroom setting. Rogers (1983) identified five general attributes of innovations that diffusion studies had shown to consistently influence adoption. He defined them as follows:

Relative Advantage: The degree to which an innovation is perceived as being better than its precursor.

Compatibility: The degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters.

Complexity: The degree to which an innovation is perceived as being difficult to use.

Observability: The degree to which the results of an innovation are observable to others.

Trialability: The degree to which an innovation may be experimented with before adoption.

Image: The degree to which use of an innovation is perceived to enhance one's image or status in one's social system.

The following two definitions are based on the work of Moore and Benbasat (1991) in developing an instrument to measure the perceptions of adopting an information technology innovation.

Demonstrability: The degree to which results of use of an innovation can be communicated to others.

Voluntariness: The degree to which use of an innovation is perceived as being voluntary, or of free will.

The recent research compared computer assisted instruction with conventional instruction. Early advocates of computer instruction predicted that computers would revolutionize education. However, the negatives such as lack of teacher training and adequate support, lack of an integrated infrastructure, and lack of a systems approach may have been the cause of a piecemeal and unintegrated use in the classroom. In addition, as late as early 1997 too few

computers along with too many students has caused technology not to be as available as expected.

A positive response to 21st Century technology usage in the classroom could be developed through sufficient availability of the electronic media. Teacher skill in the use of 21st Century technology, teacher attitudes, and teacher training contributed to the appropriate use of technology along with the compelling functions of the media.

Population and Sample

The population for the study was all K-12 Tennessee 21st Century Classroom Technology teachers. The subjects for study were the teachers in Tennessee who used the 21st Century technology equipment for the school years 1993-94, 1994-95, and 1995-96. The total population of 21st Century Classroom teachers was 5,685 in grades K-12 public schools for the three year period. In 1993-94 school year 2,496 teachers received technology equipment. In 1994-95 and 1995-96 the total number of recipients was 1,809 and 1,380, respectively. A stratified random sampling of the population was selected and surveyed. The sample was stratified by grade level and year of implementation to obtain a greater degree of representativeness and thus decrease the probability of sampling error (Babbie, 1990). According to Krejcie and Morgan (1970), an appropriate sample for the population was 500 teachers. The following process was used to select the sample:

1. A data base of 21st Century Classroom teachers was obtained from the State Department of Education of Tennessee.
2. The sample size was determined and stratified by grade level and year of implementation.
3. A systematic sampling with a random start was employed to

identify teachers to receive the survey instrument.

Pilot Test

A pilot test for the survey instrument developed by the researcher to assess teacher perceptions was administered. To establish content validity, the instrument was submitted to examination by three judges selected from the dissertation committee. Dr. George Marsh, Dr. Barrie Jo Price, and Dr. Anna McFadden were asked to serve on the panel of judges. All agreed to help validate the instrument, and copies of the questionnaire were sent to them. After initial revisions it was administered to a random sample of 20 teachers in Chattanooga Public Schools. They were asked to make any additional comments that they wished for clarification. Suggestions and comments were taken and further integrated into the instrument.

Once the questionnaire was developed, validated, and field tested, a Cronbach Coefficient Alpha statistical test was used as the standard for determining reliability of the questionnaire. The initial pilot test yielded an alpha of .90, which is considered very reliable (Hinkle, Wiersma, & Jurs, 1994). With the assistance of Dr. Marsh, Dr. Price, and Dr. McFadden final revisions were determined and made.

Research Instrument

A four-part instrument was developed to gather data for the study. Part I of the instrument (Appendix A) sought information of a demographic nature. The demographic data provided the basis for analyzing the variables of gender, current grade level assignment, and years of experience teaching, as well as, years of experience using technology. Other demographic data included other computer using teachers in the building and networking setup. The training site, selection process, and teacher's initiative for technology use was analyzed

along with the year of technology implementation in the curriculum.

Part II of the survey instrument consisted of seven questions which measured whether the respondents used the technology for the following specific tasks: lesson planning, record keeping, communication, and instructional presentation. Part III was a set of questions regarding the following constructs. The constructs voluntariness, relative advantage, compatibility, image, complexity, demonstrability, visibility, and trial ability are measurements of teachers' perceptions about the use of the 21st Century technology in the classroom setting. These items were designed to elicit responses from a five-point Likert-type scale ranging from Strongly Agree to Strongly Disagree.

Part IV of the survey instrument was composed of seven questions about the training topics of basic concepts, word processing, data base, spreadsheet, instructional software, optical technology, and telecommunications. Respondents were asked to rate the usefulness of these topics in relation to their implementation of the the 21st Century bundles. This rating ranges from Not Useful to Extremely Useful.

Analysis of Demographic Data

There was a total of 500 questionnaires distributed to elementary, middle school, and secondary 21st Century Classroom teachers in the state of Tennessee. Two hundred ninety-eight (60%) were returned. All returned instruments were usable except 50. These instruments were returned unopened due to persons no longer teaching in the school they were in when they received the technology bundle. The subjects represented different grade levels, gender, years of teaching experience, years of using technology, number of peers using technology in school, year of 21st Century technology implementation, training site, whether networked, and basis of selection to

receive a technology bundle.

A majority of the teachers, 123, were teachers in elementary K-5 grades. Middle school teachers, grades 6-8, accounted for 82 respondents. Forty respondents were classified as secondary, grades 9-12. Three teachers did not respond to the grade level item. A majority of the teachers was female (81.9%). Male teachers accounted for 18.1% of the respondents.

Fifty one percent of the teachers had 15 or more years of experience. The range of responses was categorized into four groups: 1-3, 4-6, 7-14, and 15 and above. Twenty percent of the teachers had less than 7 years experience teaching. The majority of the teachers reported having used computers for three years or less. Twenty five percent used computers for 4-6 years, while 11% indicated computer use for 7 or more years. The majority of the teachers were in schools where 16 or more teachers were also using technology. The range of responses was categorized into four groups: 0-5, 6-10, 11-15, and 16 or more. Fifty-seven percent of the teachers worked in schools where 15 or fewer teachers used computers at school.

Fifty-five percent of the teachers reported connectivity, while forty percent had no connection to a local area network.Ten teachers did not answer this item. Forty-seven percent of the teachers implemented the 21st Century technology bundle in the curriculum in the 1993-94 school year. Thirty-nine percent of the respondents implemented the technology bundle in the following school year, 1994-95. Thirteen percent of the 21st Century Classroom teachers began using the technology bundles in the third year of implementation, 1995-96.

Thirty-four percent of the teachers surveyed reported the district as being the reason for obtaining the 21st Century Classroom technology bundle. Forty-

three percent of the respondents reported self as the reason for obtaining a bundle, while only 13% were accounted for by obtaining a technology bundle through a district technology coordinator. The majority of the participants of this study, 114, were trained at a state site. Ninety one participants were trained at a local site, while 7 reported training took place at an institution of higher learning. Twenty-eight teachers indicated training took place at a combination of sites. Eight teachers did not respond to this item. Forty percent of the teachers surveyed were selected to receive bundles by the grade level, while 16 % were selected based on teacher expertise with technology. Thirty four percent of the respondents made application for selection to receive a 21st Century technology bundle.

Instrument

The instrument used in the study was developed by the investigator after a review of the literature and an examination of other perception studies. The questionnaire consisted of eleven major parts: (a) demographic information, (b) voluntariness, (c) advantage, (d) compatibility, (e) image, (f) complexity, (g) demonstrability, (h) observability, (i) trialability, (j) professional activities, and (k) training usefulness. There were 10 demographic items. There were 3 statements related to voluntariness, 9 statements related to relative advantage, 4 statements related to compatibility, 4 statements related to image, 8 statements related to complexity, 4 statements related to demonstrability, 5 statements related to observability, and 9 statements related to trialability. Seven items related to professional activities, while 7 items related to usefulness of training topics. These eleven sections of the questionnaire totaled 70 questions. A Likert-type scale was used and responses categorized as SA (Strongly Agree), A (Agree), U (Undecided), D (Disagree), SD (Strongly

Disagree).

Cronbach's Coefficient Alpha was administered to determine the reliability of the Likert-type items. The pilot reliability yielded an alpha of .90 and the alpha level for the total respondents returning the instrument was .94 while the reliability coefficients were.49 for voluntariness, .91 for relative advantage, .87 for compatibility, .85 for image, .88 for complexity, .80 for demonstrability, .78 for visibility, and .87 for trialability. According to Hinkle, Wiersma, and Jurs (1994), .94 is considered very reliable.

Analysis of the Data

A one-way analysis of variance was applied to the first hypothesis. This hypothesis stated that there will be no significant difference ($p<.05$) in the perceptions of 21st Century Classroom teachers, based on the year of implementation or grade level, regarding the training usefulness variables. At a confidence level of .05 calculated values were not greater than the critical value on any 1 of the 7 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation or grade level.

A Chi Square was applied to the second hypothesis. This hypothesis stated that there will be no significant difference ($p<.05$) in the perceptions of 21st Century Classroom teachers, based on the year of implementation, regarding the professional activity variables. Although no significant differences were found when analyzing this hypothesis by year of implementation, analysis by grade level yielded significant differences in the two activities, record-keeping and communicating with parents. Seventy percent of elementary teachers did not use technology to do record-keeping while only 7% of the secondary teachers did not use technology for that purpose.

A Kruskal-Wallis one-way analysis of variance was applied to the third hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of voluntariness, the degree to which use of an innovation is perceived as being voluntary, or of free will. At a confidence level of .05 calculated values were not greater than the critical value on any 1 of the 3 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. However, upon examining this hypothesis based on grade level, calculated values were greater than the critical value on 2 out of 3 items indicating a significant difference among the teachers.

A Scheffe test was performed to distinguish and explore the specific differences in voluntariness items 2 and 3. The difference found by performing the Scheffe occurred between elementary and middle school teachers in item 2. In item 3, no two groups were found to be significantly different at the .05 level.

A Kruskal-Wallis one-way analysis of variance was applied to the fourth hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of relative advantage, the degree to which an innovation is perceived as being better than its precursor. At a confidence level of .05 calculated values were not greater than the critical value on any of the 9 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. However, upon examining this hypothesis based on grade level, calculated values were greater than the critical value on 2 out of 9 items indicating a significant difference among the teachers. The Scheffe procedure

was completed on items 6 and 9. No two groups were significantly different at the .05 level on either item.

A Kruskal-Wallis one-way analysis of variance was applied to the fifth hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of compatibility, the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters. At a confidence level of .05 calculated values were not greater than the critical value on any of the 5 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. Upon examining the fifth hypothesis based on grade level, calculated values were not greater than the critical value on any of the 9 items, indicating no significant difference among the teachers' perceptions regarding compatibility. A Kruskal-Wallis one-way analysis of variance was applied to the sixth hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of image, the degree to which use of an innovation is perceived to enhance one's image or status in one's social system. At a confidence level of .05 calculated values were not greater than the critical value on any of the 4 items indicating no significant difference among 21st Century Classroom teachers' perceptions. Based on grade level, calculated values were not greater than the critical value on any of the 4 items, indicating no significant difference among the teachers' perceptions' regarding image in one's school district .

A Kruskal-Wallis one-way analysis of variance was applied to the seventh hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of complexity, the degree to which an innovation is perceived as being difficult to use. At a confidence level of .05 calculated values were not greater than the critical value on any of the 8 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. However, upon examining this hypothesis based on grade level, calculated values were greater than the critical value on 3 out of 8 items indicating a significant difference among the teachers.

A Scheffe test was performed to distinguish and explore the specific differences in complexity items 22, 24, and 27. The difference found by performing the Scheffe occurred between elementary and high school teachers in item 22. In item 24, no two groups were found to be significantly different at the .05 level. The difference found by applying the Scheffe test to item 27 was between the elementary and the high school teachers.

A Kruskal-Wallis one-way analysis of variance was applied to the eighth hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of demonstrability, the degree to which results of use of an innovation can be communicated to others. At a confidence level of .05 calculated values were greater than the critical value on 1 of the 4 items indicating a significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. Upon examining this hypothesis based on grade level,

calculated values were also greater than the critical value on 2 out of 4 items indicating a significant difference among the teachers' perceptions concerning demonstrability of the 21st Century technology.

A Scheffe test was performed to distinguish and explore the specific differences in demonstrability items 28, 30, and 31. The difference found by performing the Scheffe occurred between elementary and high school teachers in item 28. In item 30, the two groups found to be significantly different at the .05 level were the elementary and middle school teachers. The difference found by applying the Scheffe test to item 31 was between the elementary and the high school teachers.

A Kruskal-Wallis one-way analysis of variance was applied to the ninth hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of observability, the degree to which the results of an innovation are observable to others. At a confidence level of .05 calculated values were not greater than the critical value on any of the 5 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. Upon examining the ninth hypothesis based on grade level, calculated values were not greater than the critical value on any of the 5 items, indicating no significant difference among the teachers' perceptions regarding observability.

A Kruskal-Wallis one-way analysis of variance was applied to the tenth hypothesis. This hypothesis stated that there will be no significant interaction ($p<.05$) in the perceptions of 21st Century teachers, based on the year of implementation of the technology bundle, regarding the construct of trialability,

the degree to which an innovation may be experimented with before adoption. At a confidence level of .05 calculated values were not greater than the critical value on any of the 9 items indicating no significant difference among 21st Century Classroom teachers' perceptions based on year of implementation. Upon examining the tenth hypothesis based on grade level, calculated values were not greater than the critical value on any of the 9 items, indicating no significant difference among the teachers' perceptions regarding trialability .

Qualitative Data Summary

In addition to the quantitative data generated by the statistical analysis many respondents chose to make comments on the survey instrument. This qualitative data was compiled. These comments reflected both positive and negative feelings concerning the 21st Century Classroom technology training and implementation. The unsolicited responses from the survey participants were described as they related to the review of literature for this study and in keeping with the characteristics of qualitative research.

The areas discussed in the review of literature included the negative reasons technology may not be more prevalent in classroom use, such as inappropriate use, lack of teacher training and support, piecemeal and unintegrated use, too few computers for too many students, lack of an integrated infrastructure, and lack of a systems approach. Comments from survey participants were supported on every issue in the research.

The issues discussed in the review of the literature also included the positive reasons technology may be more beneficial for teachers in the classroom. These positive areas included the compelling functions of the media, teacher skill, teacher attitudes, and teacher training. The issues discussed were rank ordered by the concern receiving the most comments to

the concern receiving the least comments.

Lack of teacher training and technical support was the concern that more teachers reported. Nine comments were made concerning teacher training. Five remarks were noted about teacher attitudes. Four remarks each were noted on the issues of teacher skill and lack of an integrated infrastructure. Three participants commented on the compelling functions of the electronic media.

Both the issue of a lack of a systems approach and the issue of piecemeal and unintegrated use received two comments each. The two concerns receiving the least comments were inappropriate use and too few computers for too many students.

The most prevalent issue that participants commented on was lack of teacher training and technical support. Fourteen remarks were written concerning lack of teacher training and technical support. Participants described problems with equipment not being installed for use as well as inadequate training. Some participants did no feel that their initial training was good nor was there sufficient time for experimenting with equipment on the job. Participants reported having difficulty obtaining internet training or losing the e-mail capability for their classrooms. A few participants reported the 21st Century classroom training as limited and therefore were forced to teach themselves.

Participants commented on the lack of adequate support to maintain proper functioning of the technology resources. It was stated that more consideration should have been given to varying levels of computer experience at the onset of training in order for trainees to gain maximum benefit from training. Another concern reported was the length of time between the training and distribution of technology bundles. Participants reported that they forgot a lot of the training by the time bundles were received. Participants also

expressed concern that the technology coordinator should be an individual certified in computer technology. Some participants stated that when computers lock up and are not fixed for days, the technology was more of a hindrance than an additional resource. Problems with network malfunctions contributed to the teachers' frustrations. Perhaps a person more knowledgeable with the technical issues of technology could address the problems expressed by the participants.

The area of teacher training received nine comments. The concerns expressed were that not enough training took place and that the training lacked sufficient quality. Participants reported difficulty receiving internet training, database training, and spreadsheet training. Teachers expressed a desire for more training on how to integrate the technology bundles specific to the curriculum and subjects taught.

Unsolicited comments reflecting teacher attitudes were made concerning inadequate time to fit technology in the schedule. Participants stated that the time it took to implement properly was hard to find with all the other demands on curriculum. Some participants expressed the excitement that technology had brought to the classroom and to their teaching, but they needed an update in training to maintain that level of excitement.

Teacher skill and lack of an integrated infrastructure were two areas of concern expressed in the comments of participants. Though teachers did receive the required hours of training, they commented on the quality and maintenance of the original training. Some participants expressed a need to meet with other 21st Century teachers to discuss successes and failures.

The lack of an integrated infrastructure was evidenced by remarks made by teachers about ordering software. In some cases software had to be bought before training took place, and teachers felt that they did not make wise choices.

Time to observe uses, go to training, create programs and lessons were reported as inadequate.

Comments were made regarding the compelling functions of the media. Participants reported students completing numerous assignments requiring the use of technology. These assignments required the use of word processing applications, laser discs, compact discs, and scanners.

Participants made comments concerning the issue of a lack of a systems approach. Teachers reported not having the computers networked and not being connected to any other network. Participants also felt that the lack of opportunity to view software before purchasing was a disadvantage. Piecemeal and unintegrated use was a symptom of the lack of a systems approach. Comments supporting this issue were that insufficient inservice was provided and the training did not take place in a timely manner.

The final two issues that were discussed least were the inappropriate use of computers and too few computers for too many students. One participant expressed concern for training students on the software and equipment found in industry. Another participant commented on the need for a computer lab in addition to the computers in the classroom.

Findings

The statistical analysis of the collected data indicated that no significant differences existed for Hypothesis 1 by implementation year or grade level. For years 1993-94 (year 1), 1994-95 (year 2), 1995-96 (year 3), 44%, 50%, and 39% of the teachers, respectively, reported the training topic, basic concepts, to be very useful as part of their training. In all three years teachers perceived the topic to be more useful than not.

The training topic, word processing, was found to be useful to 54% of the teachers in year 1, 66% in year 2, and 73% in year 3. In all three years teachers reported the topic to be more useful to their training than not useful. Teachers reported the database topic as being moderately useful in years 1, 2, and 3.

The spreadsheet training topic was reported to be moderately useful to teachers from years 1 and 2, while only slightly useful to the teachers in year 3. The topic, instructional software, was considered very useful by teachers from all 3 years. The training topic, optical software, was reported as slightly useful in the first year of implementation, but was considered to be very useful in the following year and not at all useful in the third year of implementation.The telecommunications training topic was reported as moderately useful to very useful to 68%, 73%, and 68% of the sample teachers in years 1, 2, and 3, respectively.

Upon examination of the usefulness of the training topic by grade level, 45% of the middle school teachers and 53% of the high school teachers reported the basic concepts training topic as being very useful, while only 41% of the elementary teachers in the sample reported this perception. Elementary, middle, and high school teachers all perceived the word processing training topic as being very useful.

Forty one percent of the high school teachers believed database training to be very useful, whereas 30% of elementary and 20% of middle school teachers in the sample reported database to be very useful to them. The training concerning spreadsheet was perceived to be moderately useful by elementary teachers, while both middle and high school teachers considered spreadsheet training to be very useful.

Fifty one percent of elementary and 52% of middle school teachers in the sample perceived the instructional software training to be very useful and only 40% of the high school teachers reported instructional software training as being very useful. All three grade level teachers believed optical software training to be very useful. A larger percentage of middle school teachers than elementary or high school teachers in the sample believed telecommunications to be very useful.

The statistical analysis of the collected data indicated that no significant differences existed for Hypothesis 2 by implementation year. Although no significant differences were found when analyzing this hypothesis by year of implementation, analysis by grade level yielded significant differences in the two activities, record-keeping and communicating with parents. At the elementary level 55% of the sample teachers reported using the technology bundle for record-keeping (grade book), while 45% did not. Seventy three percent of middle school and 84% of high school teachers reported using the bundle for record-keeping. Eighty eight percent of elementary and 84% of middle school teachers communicated with parents using the bundle while only 67% of high school teachers used the technology as a tool for communication with parents.

Seventy eight percent of the teachers in 1993-94 (year 1), 81% in 1994-95 (year 2), and 73% in 1995-96 (year 3) reported planning student lessons using the 21st Century technology bundle. In all 3 years of implementation at least 88% of the teachers reported use of the technology bundle for presenting instruction.

From year 1 to year 2 about the same percentage (60%) of teachers used the bundle to communicate with colleagues, while in year 3, 75% reported

using the bundle for communication with other teachers. Each of the 3 implementation years about 50% of the teachers used the technology bundle for communication with administrators. Ninety four percent of the teachers in year 3 reported communication with parents via the bundle while only 85% and 79% did so in years 1 and 2, respectively. Seventy six percent of teachers in year 2 reported communication with students using the bundle. In year 1, 81% communicated with students, and in year 2 the percentage of teachers communicating with students via computer was 91%.

As the grade level increased so did the percentage of teachers who reported use of the bundle for planning student lessons. Ninety seven percent of high school teachers reported presenting instruction using the bundle, while 89% of elementary and 88% of middle school teachers reported this use. Approximately 60% each of elementary, middle, and high school teachers communicate with colleagues using the technology bundles.When communicating with administrators the percentages are 50% for all 3 levels. A higher percentage (86%) of middle school teachers communicate with students via technology than either elementary (78%) or high school (75%).

The statistical analysis of the collected data indicated that no significant differences existed for Hypothesis 2 by implementation year. Although no significant differences were found when analyzing this hypothesis by year of implementation, analysis by grade level yielded significant differences in two areas, voluntary bundle use and involuntary technology bundle use. The difference found was between the elementary and middle school teachers.

Teachers in all three years of implementation reported use of the technology bundle as voluntary. Five percent or less of the teachers from each year of implementation reported a superior's expectations for teachers to use

the bundle. Responses from these questions supported the construct of voluntariness of use of the 21st Century technology.

The statistical analysis of the data for Hypothesis 3 by implementation year indicated no differences. However, examination of the data by grade level yielded differences in two areas: easier and more advantageous to do the job.

Data from each of the three implementation years positively supported the item that the technology allows teachers to accomplish tasks more quickly. At least 90% of the teachers from each year reported that it improves the quality of work and is advantageous to the job. Eighty percent of the first year teachers viewed the bundle as making it easier to do the job and increasing productivity. Responses to two items in this section indicated that in year 2 of implementation a 10% larger percentage of teachers believed that the technology improved job performance and enhanced job effectiveness than in years 1 and 3.

A higher percentage of teachers in high school and middle school reported positively (Agree or Strongly Agree) on all nine items concerning the relative advantage of the 21st Century technology. The items included teachers' perceptions about accomplishing tasks quickly, improving work quality and job performance, enhancing job effectiveness, making job easier, giving greater control over work, increasing productivity, and having more advantages than disadvantages for the classroom.

The statistical analysis of the collected data indicated that no significant differences existed for Hypothesis 5, regarding compatibility, by implementation year or grade level. Responses from year 1 to year 2, and year 2 to year 3 indicated a gradual increase in percentage of teachers who perceived the technology as being compatible with aspects of work, current assignment, and teaching style.

The statistical analysis of the collected data indicated that no significant differences in teachers' perceptions existed for Hypothesis 6, concerning image in the school district , by implementation year or grade level. A higher percentage of teachers in year 3 of implementation of the 21st Century Classroom project reported improved image in the district and heightened profile as a result of bundle use. Seventy five percent of the teachers from year 3 indicated that others saw them as more valuable employees due to the use of the bundle technology. Eighty one percent of elementary teachers indicated a perceived improvement in image since becoming a 21st Century Classroom teacher. Elementary teachers also viewed themselves as as more valuable employees to a greater extent than did middle or high school.

The statistical analysis of the collected data indicated that no significant differences existed for Hypothesis 7 by implementation year. Although no significant differences were found when analyzing this hypothesis by year of implementation, analysis by grade level yielded significant differences in complexity on three items of the eight: (a) easy to remember how to perform tasks, (b) clear and understandable, and (c) easy to learn to use. Seventy one percent of the teachers in year 3, 67% in year 2, and 67% in year 3 indicated that the bundle was cumbersome to use.

The statistical analysis of the collected data indicated that significant differences existed for Hypothesis 5, regarding demonstrability, by implementation year and grade level. The differences occurred between years 1 and 3 and years 2 and 3 on the item concerning teachers being able to explain the benefits to using the 21st Century technology. Eighty six percent of the teachers in years 1 and 2 expressed difficulty in explaining benefits of the technology while only 59% expressed the same in year 3.

The differences in grade level groups occurred between elementary and high school teachers on item 28 and elementary and middle school teachers on item 30. Ninety percent of high school teachers believed they would have no difficulty explaining the results of using the technology to others, while only 73% of elementary teachers believed this. Ninety four percent of middle and high school teachers indicated that the results of using 21st Century technology bundle were apparent and 86% of elementary teachers considered that results were apparent.

The statistical analysis of the collected data indicated that no significant differences in teachers' perceptions existed for Hypothesis 9, concerning observability in the school district , by implementation year or grade level. Fifty seven percent of the teachers from year 3, and 68% each from years 1 and 2 indicated that it was not easy to observe other 21st Century bundle users in their districts. Lack of opportunities to observe bundle usage was indicated by 61% of the teachers in year 1, 74% in year 2, and 66% in year 3. Eighty percent of high school teachers have seen what others are doing with bundles in the district as compared to 75% and 67% of the middle and elementary schools, respectively.

The statistical analysis of the collected data indicated that no significant differences in teachers' perceptions existed for Hypothesis 10, concerning trialability of the 21st Century technology bundles, by implementation year or grade level. Sixty percent of teachers from all three years of implementation indicated a lack of opportunity to try various applications. Approximately 50% of the teachers from each year indicated that they know where to go to try various uses of the bundle. Fifty percent or more from each year indicated that the technology bundle was not available to them to adequately test run

applications. Having enough people for support and assistance was expressed for 68% of teachers from year 3, 54% from year 2, and 52% from year 1. Examination of items concerning trialability by grade level indicated the teachers in middle and high schools (46%) perceived themselves as having the opportunity to experiment with the 21st Century technology as compared with 42% in elementary schools.

Conclusions

The following conclusions were drawn based on the findings of the study:

1. Although no statistical difference was found among the teachers' perceptions by grade level or by year, from the responses the teachers gave, the researcher concluded that all of the training topics were perceived to be useful in implementation of the 21st Century Classroom Bundle technology.

2. No statistical difference was found in the teachers' perceptions by year concerning the professional activities. The responses indicated that the longer teacher had the bundle the more it was used for professional activities.

3. Regarding voluntariness, the responses by grade level suggested that elementary teachers have not volunteered for bundles as readily as middle and high school teachers. As the years have progressed more teachers have volunteered.

4. All three grade level and all three year groups clearly indicated the relative advantage of having and using a 21st Century technology bundle.

5. All three grade level groups viewed the technology bundle as enhancing their image, more from year 3 than either of the other two years.

6. From the responses concerning complexity it was concluded that the longer a teacher had a bundle the easier it was to use. Teachers in lower grades were not as comfortable with the complexity as teachers in higher

grades.

7. Regarding demonstrability, the elementary teachers' responses indicated less confidence to demonstrate than did middle, and middle teachers' responses indicated less confidence than high school teachers.

8. The responses from all teachers indicated a gradual increase in observability as grade increased.

9. Responses indicated that more teachers in year 3 were able to try applications than teachers in other years. As the grade level increased so did teachers' trialability of the technology.

Recommendations

Based on the findings, the following recommendations are suggested:

1. The 21st Century Classroom Project should continue to use all training topics in the state mandated training of teachers.

2. Ongoing evaluation of the 21st Century Classroom should take place.

3. Teacher training for the technology bundle should take place upon receipt of equipment.

4. A more differentiated training may need to take place for teachers in various grade levels.

Implications

On the basis of the findings and conclusions of this study, it is implied that technology training for teachers is required to implement technology in the classroom. Teachers need time and support to accomplish this.

Finally, this study implies the need for further studies to assess the overall effect of the 21st Century technology on teaching effectiveness in Tennessee. It is necessary to determine training effectiveness before subsequent studies can uncover the true influence of technology on teaching.

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